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THE EXTERNAL MORPHOLOGY OF CHRYSOPA PERLA L. (NEUROPTERA: CHRYSOPIDÆ)*

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INTRODUCTION

The purpose of this thesis is to make a complete morphological study of a typical chrysopid with the hope of finding morphological characters which may be used as a basis for future systematic work on the group. Color and wing venation have been largely used in the group for specific differences, but many present taxonomists find that body morphological characters are of more value for systematic work.

The Palearctic *Chrysopa perla* L. was selected for two reasons; first, it is typical of the family and, second, the sutures demarking the sclerites are more distinct than in any of the native species.

Dr. G. C. Crampton furnished the material which he collected in Norway. The writer was also very fortunate in securing from Staudinger and Bang-Haas, Germany, eight specimens of *Chrysopa perla*, three of which were determined by L. Navás.

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HISTORY

Linnaeus (1758) described *Hemerobius perla* as "*H. viridis*, alis hyalinis: vasis viridibus." Leach (1815) made a new genus *Chrysopa* in which he placed *H. perla* and put this genus in a new family Hemerobida. Westwood (1840) designated *perla* as the genotype of *Chrysopa*. Schneider (1851) divided Hemerobidæ into three divisions and placed *Chrysopa* in Chrysopina. Hagen (1866) made Chrysopidæ a subfamily of Hemerobidæ and in so doing made *Chrysopa* the type genus. MacLachlan (1868) raised Chrysopidæ to the rank of family. The various stages in our knowledge of this subject may be shown by the accompanying table.

Linnaeus 1758	Phryganea Hemerobius <i>perla</i>	Hemerobius <i>perla</i> described
Leach 1815	Hemerobida Chrysopa <i>perla</i>	Chrysopa became a genus
Westwood 1840	Hemerobiidæ Chrysopa <i>perla</i>	Chrysopa <i>perla</i> became the genotype
Schneider 1851	Hemerobidæ Chrysopina Chrysopa <i>perla</i>	Chrysopina designated as a division
Hagen 1866	Hemerobidæ Chrysopidæ Chrysopa <i>perla</i>	Chrysopidæ designated as a subfamily; Chrysopa became the type genus
MacLachlan 1868	Hemerobiina Chrysopidæ Chrysopa <i>perla</i>	Chrysopidæ raised to family rank

The chief workers on the group are: Banks (1909), Brauer (1850), Hagen (1861, 1866), MacLachlan (1868), McDunnough, (1909), Navás (1925), Pariser (1919), Petersen (1927), Pongrácz (1919), Schneider (1851), Smith (1922), Stitz (1927?), Tichomirowa (1892), Tillyard (1916) and Withycombe (1922).

DISTRIBUTION

Chrysopa perla has a wide range in Eurasia, being found in Great Britain, throughout continental Europe as far north as Scandinavia and Finland and south to Hungary, and in central Siberia.

GENERAL APPEARANCE

Chrysopa perla as compared with other members of the family is of medium size. There is, however, noticeable variation of size within the species. In general its color is blue green. The longitudinal veins of the wings are green while the greater number of the cross-veins are dark brown. The head is yellowish-green with a dark brown spot on the gena and each side of the clypeus. Between the antennæ is an X-shaped marking which is continued on top of the head as a forked band, the arms of which meet a transverse band at the back of the head. The antennæ which are shorter than the wings are a pale reddish-brown; the basal segment is yellowish-green with brown at the proximal end; the second segment is dark brown with light brown edges. The thorax is green, with two dark brown spots on each side of the prothorax and dark symmetrical spots on the meso- and metathorax. The legs are green. The pleurites of the abdomen are dark green, while the tergites and sternites are dark brown with green edges.

EXTERNAL MORPHOLOGY

Head and its Appendages

The head, from the frontal aspect, is somewhat circular in outline, arching slightly at the vertex. There are no sexual characters on the head. Most of the sutures which in many insects demark the various sclerites of the head capsule are absent in *Chrysopa perla*. Thus as the sclerites are not distinctly sepa-

rated, the names in most cases apply merely to areas in general rather than to clearly defined parts.

Head capsule (Pl. I, Figs. 4, 8) : The areas making up the head capsule are the occiput, vertex, frons, genæ, postgenæ, gula, clypeus, and labrum.

The *occiput* (ocp) is the caudal portion of the head dorsad of the *occipital foramen* (for). The occipital foramen is the posterior opening in the head capsule through which the alimentary canal, nervous system and other organs pass back into the thorax.

The *frons* (fr) and *vertex* (v) occupy the dorsal area of the head. The vertex is slightly arched dorsally and, from a frontal aspect, appears as a large median lobe, with a smaller one on each side which extends to the dorsal margin of the eyes. The *temporal sutures* (ts) extend forward from the *occipital suture* (os) and demark the temporal regions. The epicranial suture present in many insects demarking the frons and vertex is lacking, thus causing these regions to appear as one area. The frons is bounded laterally by the *frontal sutures* (fsu) and anteriorly by the *epistomal suture* (esu).

The *frontal pits* (frp) lie in the anterior portion of the frontal sutures. They are clearly defined depressions which externally mark the internal invaginations of the body wall forming the anterior arms of the tentorium.

The *compound eyes* (e) which are large, semi-spherical and many faceted are dorso-lateral in position. They are a beautiful golden color in life, and very iridescent. There are two *antennifers* (anf) in each antennal socket. These are heavily sclerotized projections from the inner and outer ventro-lateral margins of the antennal sockets.

The *antennæ* (Pl. I, Fig. 3) are long, delicate, filiform appendages and are approximately three-fourths as long as the fore wings. They vary greatly as to the number of segments composing them. The first segment, or *scape* (scp), is flattened and much broader and longer than the other segments. The basal end is the broader and is colored dark brown. The second segment, or *pedicle* (pd), is dark brown in the central portion. It is slightly shorter than the scape, cylindrical and slightly con-

stricted in the middle. The remaining segments form the *flagellum* (fl) and are encircled by four rows of setæ. The third segment is not so broad or so long as the pedicle. The fourth segment is the shortest. The fifth and succeeding segments are subequal and are longer than the fourth, but are shorter than the third. The distal segments taper very slightly, the last being pointed at the apex.

The *genæ* (ge), or cheeks, are the anterior portions of the latero-cephalic regions just behind and below the compound eyes. The frontal sutures demark the frons from the genæ. The genæ are bounded anteriorly by the *subgenal sutures* (sgs). Postero-laterally they merge into the *postgenæ* (pge) since no suture separates the two. The postgenal region is the cephalo-ventral surface of the head capsule on each side of the foramen.

The *gula* (gu) (Pl. II, Fig. 10) is a sclerite in the postero-ventral portion of the head capsule and does not form a part of the skull. It is a narrow transverse plate with anteriorly directed arms, bearing the labium at its cephalic end.

The *gular pits* (gup) are located at the postero-lateral edges of the gula. These pits are external depressions marking the positions of the posterior arms of the tentorium.

The *clypeus* (cl) occupies about one-third of the frontal portion of the head capsule and extends from the *labrum* (lr) posteriorly to the epistomal suture. This suture is well marked and extends between the anterior ends of the frontal sutures, arching slightly in the middle. The latero-distal angles of the clypeus are rounded. Just above and parallel with the distal margin is a row of slight depressions, each containing a seta.

The *labrum* (lr) is a narrow, transverse sclerite with its apical margin arcuately concave, and its latero-distal angles are broadly rounded.

Tentorium (Pl. I, Figs. 7, 8):—This is very well marked as a heavily sclerotized internal skeleton of the head. It is composed of the *body of the tentorium* (tnt), and three pairs of arms, namely, the *anterior arms* (at), the *posterior arms* (pt), and the *dorsal arms* (dt). Fig. 7 is a mesal view of the endoskeleton along its median axis and shows only one half of it.

One end of each anterior arm leads forward to the frontal pit; the other extends in a caudo-mesal direction, expanding along its mesal margin, then narrows for a distance and extends farther caudad until it finally fuses with the corresponding end of the other arm, forming a bridge (tnt) at its caudal extremity. From this bridge, or body of the tentorium, the two posterior arms extend laterally and posteriorly, leading back to the gular pits.

The dorsal arms are sclerotized, thread-like structures arising from the lateral margins of the anterior arms. They extend upward and become attached to the dorsal wall of the head capsule in the region of the antennæ.

Mandibles (md) (Pl. I, Fig. 4; Pl. II, Figs. 11, 12):—These are well developed and fitted for crushing. They are pyramidal with three faces. The outer face, appearing as a continuation of the lateral aspect of the head, tapers mesally and joins with the other faces to terminate in an acute apex.

The inner margin of the right mandible (Pl. II, Fig. 11) is convex in the basal region but is concave for about one third of the distance to the apex. The basal portion of the convex area is the *submola* (smo). The anterior region of the convex and posterior of the concave margin is the *mola* (mo). The apical portion of the mesal edge is the *incisor region* (in).

The left mandible (Pl. II, Fig. 12) differs from the right in that the basal portion of the inner margin gradually curves convexly and terminates in an acute tooth, the *mola* (mo), which is about midway between the base and apex of the mandible. From the mola the mesal edge extends laterally toward the outer surface, then turns and extends vertically for a short distance to the apex.

On the anterior face of each mandible a sharp edge runs dorsally for a short distance from the mid-submolar region parallel with the mesal edge, reverses its course for a short way, goes laterally toward the outer margin, turns and extends not quite parallel with the outer margin to the apex. On the anterior surface of each mandible is a *brustia* (br), or row of setæ, which is adjacent to the submola and curves inward to the second turn of the edge just referred to.

The basal portion of each mandible is triangular in shape. Each mandible has two articulatory points for movement, the *ginglymus* (g) and *condyle* (c). The ginglymus is at the anterior end of the lateral edge. This is a depression, or socket, which fits over a condyle-like projection in the latero-basal edge of the clypeus, forming a ball and socket articulation. The posterior end of the lateral edge bears a well developed condyle which fits into a socket in the latero-ventral margin of the postgena. There are two tendons to furnish movement of the mandibles. An *extensor tendon* (et) extending from the mid-portion of the basal edge of the lateral face to the head opens the mandible, while a *flexor tendon* (ft) from the meso-basal region of the mandible closes it.

At the base of each mandible may be seen a small U-shaped sclerite, the *basimandibula* (bm). If we are to accept the idea of Crampton (1921) in his study of the external anatomy of the head of insects, this plate was probably formed by a sclerotization of a part of the mandibular membrane between the base of the mandible and the head capsule.

Maxillæ (mx) (Pl. I, Fig. 4: Pl. II, Fig. 9):— The maxillæ are ventrad of the mandibles. Each maxilla consists of five principal parts and two free portions. The primary parts are the cardo, stipes, palpifer, basigalea, and distigalea. The free portions are the lacinia and labial palp.

The cardo, or basal sclerite, is divided into the *basicardo* (bc) and *disticardo* (dc). The disticardo is long and quadrangular. The basicardo is smaller and has a convex anterior edge. The meso-basal portion of the disticardo bears a prominent articulatory condyle. The *stipes* (st) is a large subquadrangular sclerite forming the intermediate portion of the maxilla. Two narrow strips, not demarked by distinct sutures, lie along the inner and outer margins of the stipes.

The *palpifer* (pfr) is on the latero-distal angle of the stipes. The *maxillary palp* (mp) is borne by the palpifer and is composed of five segments. The two basal segments are subequal in size, the second being the smaller, but shorter than the three terminal ones. These three are also subequal, the apical one being the longest and pointed at the tip.

The galea, or external lobe of the maxilla, is composed of two segments, the *basigalea* (bg) and *distigalea* (dg). According to Crampton (1923), the division of the galea into a basigalea and distigalea is a primitive survival that has been retained in the Neuroptera. The basigalea is the proximal U-shaped sclerite. The distigalea is much larger with the outer margin curving mesad. The apical region is clothed with hairs. The apical portion of the distigalea is not so heavily sclerotized as the rest of the sclerite.

The lacinia, or inner maxillary lobe, attached to the distal end of the stipes is mesad of the galea. It is composed of two parts, the *basilacinia* (bl) and *distilacinia* (la). The basilacinia is distad of the stipes, weakly sclerotized basally and more heavily sclerotized apically. The outer edge is sclerotized, giving a stiffening effect to the less heavily sclerotized distilacinia. The outer margin of the distilacinia sweeps downward and then upward in a broad curve while the inner margin extends downward and then mesad, both margins terminating at the broad mesal edge. There is a small group of hairs on the posterior portion of the mesal edge.

Labium (Pl. II, Fig. 10):—The basal sclerite of the labium is largely made up of the *submentum* (sm), although the posterior region of the basal sclerite contains the *gular region* (gu). The submentum has a broadly and sinuately incised anterior margin. In front of the submentum is a membranous area, which is bounded anteriorly by a convexly curved, narrow sclerite, the *mentum* (mn).

In front of the mentum is a small triangular region, the *interlabium* (il). The *palpigers* (pgr) are on each side of the interlabium, and the area between these and the interlabium is not so heavily sclerotized as the palpigers and interlabium. Each palpiger bears a three segmented *labial palp* (lp); the first segment is shortest, the second is longer, and the third is the longest and is pointed at the tip.

Anterior to the palpigers is a slightly sclerotized area which merges into a heavily sclerotized *labiostipes* (lst). The lateral margins of the labiostipes curve outwardly, making the distal end broader than the basal end. The glossæ and paraglossæ

have fused and form a large *membranous lobe* (pg) surrounding the labiostipes. The distal edge of this lobe is truncate and the lateral edges are deflexed posteriorly.

Thorax and its Appendages

The thorax bears the legs and wings and, because of this, great stress is brought upon it by the movement of these appendages. To allow for this stress some of the body wall is membranous, thus permitting its movement. The principal membranous regions are the cervix, prothoracic pleural region, intersegmental regions, and the regions at the articulation of the wings and legs. The apodemes are sclerotized internal ridges for muscle attachment.

There are two *spiracles* (sp) in the thorax, one in the mesothorax and one in the metathorax. The mesothoracic spiracle is situated in front of the mesopleuron. It is a slit-like opening in the body wall, surrounded by a rather oblong-shaped sclerite, the peritrema. The metathoracic spiracle is in front of the metapleuron. This is a circular aperture in the body wall, encircled by a sclerotized plate.

The papers of chief help in a study of the thorax and its appendages are those of Snodgrass (1909 and 1927) and Crampton (1909, 1914 and 1926). Martin's paper (1916) on the thoracic and cervical sclerites of insects is also of interest.

Cervix (Pl. III, Fig. 16):—The cervix, or neck region, is membranous and contains three intersegmental plates, or cervicalia. The *dorsal lateral cervicale* (dle) is a medium-sized triangular plate in front of the pronotum. According to Crampton (1914), the dorsal lateral cervicale is probably a detached plate belonging to the segment in front of it.

There are two lateral cervical sclerites in the pleural region. The *laterocervicale* (lc), the largest of the cervical plates is ventrad of the dorsal cervicale. The *postcervicale* (poc) is a small, oblong sclerite postero-dorsad of the laterocervicale and appears cut out leaving a concavity into which the postcervicale may go when the head moves to one side.

Prothorax (Pl. III, Fig. 16):—The prothorax appears as an elongated, depressed segment. The *pronotum* (pn) has a slight

mesal depression, is broader than long, and is rounded at its anterior end.

Of the two pleural sclerites, the *episternum* (es), which is ventrad of the lateral edge of the pronotum, is an elongated sclerite narrowed anteriorly and broadened posteriorly. The anterior end is forked and the dorsal end of the postcervicale fits into the crotch. The *epimeron* (em), which is posterior to the episternum, is a narrow sclerite elongated in a dorso-ventral direction. The greater portion of the pleuron is membranous.

The *basisternum* (bs) is a large sclerite somewhat diamond-shaped with the posterior portion narrowed for a short distance and then broadened caudad, forming the *furcasternum* (fs).

There is no precoxal bridge uniting the sternal region with the pleural region. Crampton (1926) gives an excellent discussion of the precoxal bridge in Neuroptera. According to his theory, the absence of this bridge in *Chrysopa perla* gives a condition suggestive of the tendencies exhibited by the higher Holometabola.

Mesothorax (Pl. III, Figs. 14, 16):—The tergum is divided into a pretergite, prescutum, scutum, scutellum, parascutellum, postergite, and postscutellum. The sutures separating the tergal sclerites are for the most part slightly depressed, giving an arched appearance to the sclerites.

A *marginal sclerite* (ms) which is anterior to the *pretergite* (prt) is probably a demarked portion of the tergum of the mesothorax. The pretergite is a narrow sclerite anterior to the *prescutum* (psc). The prescutum is a larger triangular arched plate laterally and posteriorly demarked from the *scutum* (sc) and mesally demarked from the pretergite on the other side. The scutum, the largest tergal plate, forms a broadly-rounded, elevated median lateral area and narrows in the dorso-median region. The lateral edges of the scutum are fused anteriorly with the prescutum and posteriorly with the *scutellum* (sl) and *parascutellum* (ps). Situated anteriorly and laterally, the scutum bears a rounded articulatory process, or *suralare* (l), with which the wing veins articulate by means of a small movable articulatory plate, the *notopterale* (ax). Behind the suralare is a slight indication of a weakly developed *median articulatory*

process (6). This median process extends toward the notopterales and forms a second anterior notal pivotal point for the wing. The scutellum is caudad of the scutum and is the second largest mesothoracic tergal sclerite. The scutum and scutellum are separated along the line of the internal V ridge which, according to Snodgrass (1909), is typical of the Neuroptera. Externally, no suture can be seen separating the scutellum from the parascutellum which is laterad of it. A narrow, posterior, marginal sclerite, the *postergite* (pot), which is raised on its lateral surface, bears at its antero-lateral edge an *adanal process* (2) which forms a posterior notal point for the wing. The posterior tergal sclerite, the *postscutellum* (psl), is connected with the pleural region and internally bears the *phragma* (pm) (Fig. 14).

The basal alar region is a membranous area in which are seven sclerotized plates, or ossicles; namely, the tegula, notopterales, medials and basanals which are dorsal, and the intraalare, posterior basalar plate, and subalar plate which are ventral.

The *tegula* (tg) is a small triangular sclerite which is anteriorly located. The so-called first axillary, or *notopterales* (ax), is a slightly larger, somewhat triangular ossicle caudad of the anterior articulatory process, or suralare. According to Cramp-ton (1928a), the notopterales is apparently a detached portion of the lateral margin of the notal region. The notopterales is hinged by its inner margin to the edge of the tergum, with its anterior part supported by the suralare. It also articulates with the median process. The outer margin articulates with the *medial plates* (not figured) which Snodgrass (1927) believes may be derived from the proximal end of the radial vein with which they are continuous. The third axillary, or *basanal* (not figured), is the smallest and articulates with the posterior, or adanal wing process of the tergum. The outer edges of the basanal are associated with the bases of the anal veins.

Immediately dorsad of the anepisternum is the *intraalare* (not figured). The *posterior basalar plate* (aba) is ventrad of the suralare. The largest alar sclerite is the elongated *subalar plate* (sa) located ventro-caudad of the posterior basalar plate.

The pleuron of the mesothorax is divided into an anterior portion, the episternum, and a posterior portion, the epimeron. These in turn are subdivided into smaller sclerites.

The episternum and epimeron are separated by the pleural suture which extends from the pleural wing process, or *alifer* (o), to the pleural coxal process, or *coxifer* (5). Crampton (1909) applies the terms *anepisternum* (aes) and *katepisternum* (kes) to the upper and lower regions respectively of the episternum. These are separated by a narrow strip which represents the median part of the episternum. Crampton (1914) brings forth the view that such a strip is probably part of the episternum which has become fused with the sternum to form a pre-coxal bridge. This whole region is designated as the *mesosternum* (s). A division demarking the anepisternum is retained, but the region below it uniting with the sternum is not demarked from the latter. This composite region, called the sternopleura, is composed of the region below the anepisternum fused with the sternum. The posterior portion of the mesosternum together with the anterior portion of the katepisternum furnishes an *articulatory process* (4) for the coxa. The katepisternum ventrally appears to bear the *trochantin* (tn) which is an elongated sclerite extending ventro-anteriorly. From an external view a true suture cannot be seen separating the katepisternum and trochantin, but an internal view of this shows clearly that such a suture is present. Crampton (1914) suggests that the trochantin may possibly be a detached sclerite of the pleural plate, though others suggest that it (and the pleural sclerites also) represents detached portions of the leg.

The epimeron which is posterior to the episternum is likewise divided into an upper region, the *anepimeron* (aem), and a lower region, the *katepimeron* (kem). These terms were proposed by Crampton (1909). The epimeron is not so definitely subdivided as the episternum. A suture extends from the posterior edge in a ventro-anterior direction for a distance of about half the width of the epimeron, thus only partially subdividing it into its two parts. The anepimeron is much larger than the anepisternum and the katepimeron is much smaller than the katepisternum. The epimeron is more heavily sclerotized on its ventral and lateral edges. Dorsally, the anepimeron is deeply incised for the reception of the basalar and subalar plates. The dorso-anterior portion of the anepimeron which is

the pleural fulcrum, or alifer, of the wing is slightly notched. The anepimeron also dorsally bears an *articulatory process* (3) for the posterior portion of the wing base.

The coxa of the mesothoracic leg is much larger than that of the prothoracic leg. It consists of a *eucoxa* (ecx) and a *meron* (me). The meron, which is well developed in *Chrysopa perla* is a demarked posterior basal lobe of the coxa. The eucoxa is the larger and makes up the rest of the coxa. The coxa articulates with the coxal bearing process (4) and the coxifer (5).

Metathorax (Pl. III, Figs. 15, 16) :—The tergum is composed of a pretergite, prescutum, scutum, scutellum, parascutellum, postergite, and postscutellum.

Externally the *marginal sclerite* (ms), which is probably a demarked portion of the metathoracic tergum, and the *pretergite* (prt) are not seen when the parts are in their natural position, but upon examination of the endoskeleton these can be plainly brought to view. The *prescutum* (psc) is a narrow sclerite which posteriorly fuses with the *scutum* (sc). The scutum is the largest tergal sclerite and appears to occupy the greater part of the metathoracic tergum as compared with the scutum of the mesothoracic tergum. Situated anteriorly and laterally, the scutum bears a rounded articulatory process, or *suralare*, (1) with which the wing veins articulate by means of a small movable articulatory ossicle, the *notopterale* (ax). Behind the suralare is a slight indication of a weakly developed *median articulatory process* (6). This process extends toward the notopterale and forms a second anterior notal pivot for the wing. The posterior tergal sclerite, the *postscutellum* (psl) connects with the pleural region. The *phragma* (pm) is internally borne by the postscutellum.

The alar region of the metathorax is like that of the mesothorax. This membranous area has the seven following ossicles: the tegula, notopterale, medials and basanals which are dorsal, and the intraalare, posterior basalar plate and subalar plate which are ventral.

The *tegula* (tg) is a small anterior triangular sclerite, while the *notopterale* (ax) is a slightly larger, somewhat triangular ossicle caudad of the suralare. The notopterale on its inner

margin articulates with the suralare and median process, and on its outer margin with the *medial plates* (not figured) which are at the base of the radial vein. The smallest axillary, the *basanal* (not figured), is at the bases of the anal veins and articulates with the adanal wing process.

The *intraalare* (not figured) is dorsad of the anepisternum. Immediately ventrad of the suralare is the *posterior basalar plate* (aba). The elongated *subalar plate* (sa) is ventro-caudad of the posterior basalar plate.

The pleural region is divided into an episternum and epimeron which are separated by the pleural suture. This suture extends from the *alifer* (o), or pleural wing fulcrum, to the pleural coxal process, or *coxifer* (5).

In the episternum the upper portion, or *anepisternum* (aes), is separated from the lower portion, or *katépisternum* (kes), by an intermediate strip of the episternum which unites with the *metasternum* (s), similar to that separating the corresponding sclerites in the mesothorax.

As is the case in the mesothorax, the *katépisternum* ventrally appears to bear the *trochantin* (tn). The ental surface shows a clearly marked suture separating these. The posterior portion of the metasternum together with the anterior portion of the *katépisternum* furnishes an *articulatory process* (4) for the coxa.

The metathorax differs from the mesothorax in that the division of the epimeron into its subregions, *anepimeron* (aem) and *katépimeron* (kem) is made by a complete suture whereas in the mesothorax the corresponding suture extends only half way across the epimeron. The metathoracic *anepimeron* is smaller than the mesothoracic *anepimeron*, while the metathoracic *katépimeron* is larger than the mesothoracic *katépimeron*.

The postscutellum of the mesothorax which is continued posteriorly in the *first abdominal tergite* (lt) extends ventrally and encloses the *first abdominal spiracle* (sp). The region surrounding the spiracle unites with the metathoracic epimeron at the posterior end of the suture which divides it into two parts.

The metathoracic coxa is divided into two regions, a posterior basal lobe, the *meron* (me), and an anterior larger portion, the *eucoxa* (ecx).

Endoskeleton of the meso- and metathorax (Pl. II, Fig. 13; Pl. III, Figs. 14, 15):—The endoskeleton is composed of inwardly directed processes, or apodemes, which serve for muscle attachment and for the support of other viscera.

In the tergal region of the mesothorax (Fig. 14) internal foldings, or ridges, can be seen demarking the various tergites. The infolding of the body wall along the median line between the *marginal sclerites* (ms) and *prescutums* (psc) of both sides forms an internal median ridge. The internal ridge demarking the scutellum and *parascutellum* (ps) is very prominent yet there is no indication of such a demarkation externally. This ridge is formed by the infolding of the body wall between the scutellum and parascutellum. The *postscutellum* (psl) bears an internal lobe, the *phragma* (pm).

The metathoracic tergal region (Fig. 15) shows no median ridge dividing the marginal sclerite and prescutum. There is a very distinct ridge separating the prescutum and scutum. The ridge demarking the scutum from the parascutellum is not as broad as the corresponding ridge in the mesothorax. The metathoracic phragma is small and ventrad of the postscutellum, while that of the mesothorax is large and caudad of the postscutellum.

In the pleural region an apodeme, the *pleural ridge* (pr), extends from the *alifer* (o) to the *coxifer* (5). This ridge is formed by an infolding of the body walls between the episternum and epimeron and is the largest apodeme in the endoskeleton. The pleural ridge gives off a *pleural arm* (pa) which extends to and fuses with the furcal arm, or *furca* (f) of the sternum. The pleural ridge serves as attachment for the muscles extending to the trochantin and coxa.

In the mesothorax, the epimeron is bounded posteriorly by a broad internal ridge, whereas there is no such ridge on the metathoracic epimeron. Both the meso- and metathoracic anepisterna bear an inner dorso-anterior plate.

The metathorax differs from the mesothorax in that the division of the epimeron into its subregions, anepimeron and katepimeron, is represented by a complete ridge whereas in the mesothorax the corresponding ridge extends only half way across the

epimeron. The *trochantins* (tn) of both the meso- and meta-thorax are distinct sclerites demarked from the katepimera.

The meso- and *metasterna* (s) in figure 16 seen from within are made up of three parts, namely, the laterosternum, basisternum and furcasternum. The *laterosternum* (ls) unites ventro-mesally with the *basisternum* (bs), which in its median portion is rolled inward as a well defined ridge. The ridge separating the posterior region of the laterosternum from the anterior portion of the katepisternum is clearly demarked. The *furcasternum* (fs) is caudad of the basisternum and like it bears an internal apodeme. The furcasternum posteriorly extends into a furcal arm, or *furca* (f).

The position and shape of the phragma and furca of the mesothorax are shown in figure 13.

Legs (Pl. II, Figs. 5, 6):—The mesothoracic leg has been chosen for discussion but the marked differences between this and the other legs will be brought out.

The coxa, or proximal segment, has the appearance of a truncated cone. It is divided into a large anterior portion, the *eucoxa* (ecx), and a smaller demarked basal lobe, the *meron* (me). The meron never takes part in the trochanteral articulations (Snodgrass 1927). The coxa articulates with the coxal bearing process and coxifer of the mesopleuron. The distal end of the eucoxa bears three *articulatory processes* (1, 2, 3) for the trochanter. The coxa of the prothoracic leg is much smaller and consists of two small elongated sclerites, the smaller anterior one being the eucoxa, and the larger posterior one, the meron.

The second segment of the leg is the *trochanter* (tr) which is a small quadrangular segment immovably joined to and sharply demarked from the *femur* (fe).

The femur and the following segment, the *tibia* (ti), are elongated cylindrical segments. The distal end of the tibia articulates with the *tarsus* (ta). On the ventral portion of the tibia at its distal end is a movable *tibial spur* (tis).

The tarsus is composed of five segments, the two terminal ones being the longest. The last tarsal segment, or distitarsus, bears the claws, or *ungues* (pta), and the *arolium* (ar). The ungues are hooked at the base and are connected ventro-basally with

the sclerotized plate which is separated from the ventro-distal portion of the last tarsal segment by a membranous portion.

Ventrad of the distal portion of the distitarsus is a pad-like structure, the arolium. Two bristles extend dorso-distad from the membrane between the prætarus and the last tarsal segment.

Wings (Pl. I, Figs. 1, 2) :—The venation of *Chrysopa perla* is highly specialized, and a correct interpretation of that of the adult can best be understood by first considering the pupal tracheation. However, as such a study was impossible in the time available for the preparation of the present thesis, the writer has adopted the conclusions of Tillyard (1916) and Smith (1922), who have described the wing venation of *Chrysopa signata*, *Chrysopa nigricornis* and *Chrysopa oculata* on the basis of the tracheation of the pupa.

The following quotation from Tillyard (1916) summarizes our present knowledge of the specialized venation in the family Chrysopidæ:

“The solution shows us, indeed, that the wing-venation of the *Chrysopidæ* is not only, as Petersen suspected, ‘the most abnormal of all the families,’ but that it is indeed one of the most abnormal and highly specialised venations to be found within the Insecta. Judged from this standpoint, the *Chrysopidæ* stand far and away above all other Neuroptera in the effect and extent of their wing-specialisation.”

The system of nomenclature here adopted is a combination of the Comstock-Needham and Tillyard interpretations. The tracing of the veins is in accordance with the views of Tillyard (1916), while the nomenclature of Comstock and Needham has been applied to the main veins. The cells are given the terms proposed by Tillyard.

In the Chrysopidæ the original media and cubitus have become reduced and contorted. The two resultant veins, the so-called pseudomedia and pseudocubitus, have become excessively complex and are peculiar to this family.

The *costa* (C) is the anterior marginal vein. The *subcosta* (Sc) appears to end beyond the pterostigma and near the tip of the wing. However, pupal tracheations of other species show

Modification of Comstock- Needham and Tillyard Systems	Tillyard Notation <i>C. signata</i>	Comstock-Needham Notation <i>C. nigricornis</i>
Costa	C	C
Subcosta	Sc	Sc
Pterostigma	pt	
Radius	R	R
1st radial	R ₁	R ₁
2d radial	R ₂	
3d radial	R ₃	R _{2a}
4th radial	R ₄	R ₃
5th radial	R ₅	R ₄
6th radial	R ₆	R ₅
Radial sector	Rs	Rs
Median	M	M
1st media	M ₁	M ₁
2d media	M ₂	M ₂
3d media	M ₃	M ₃
4th media	M ₄	M ₄
Pseudomedia	M ¹	M ¹
Cubitus	Cu	Cu
1st cubitus	Cu ₁	Cu ₁
2d cubitus	Cu ₂	Cu ₂
Pseudocubitus	Cu ¹	Cu ₁ ¹
1st anal	1A	1A
2d anal	2A	
3d anal	3A	
Inner gradate series	g	
Outer gradate series	g ¹	
Distal forks	df	
Posterior branches from radial sector	s ₁ -s ₁₂	
Subcostal cross vein	x	Sex
Origin of radial sector	rf	rf
Medial fork	mf	mf
1st cubital fork	cuf	cuf
2d cubital fork	cuf ¹	cuf ¹
Radial cell	r	
Upper series of Banksian cells	b	b
Lower series of Banksian cells	b ¹	b ¹
1st medial cell	m ₁	m ₁
2d medial cell	m ₂	m ₂
3d medial cell	m ₃	m ₃
1st intramedial cell	im ₁	im ₁
2d intramedial cell	im ₂	im ₂
Cubital cell	cu	cu
1st intracubital cell	icu ₁	icu ₁
2d intracubital cell	icu ₂	icu ₂
3rd intracubital cell	icu ₃	icu ₃
Posterior series of cells	p	p

R₂ at the margin

that the subcosta ends at the inner border of the pterostigma, and in the adult the stigmal cross-veinlets have fused giving Se the appearance of extending nearly to the wing tip. There are many veinlets between the costa and subcosta. The main *cross-vein* between the subcosta and radius is at (x) in the fore wing although there are a few cross-veins between the terminal portions of these main veins. The *pterostigma* (pt) is a membranous area between the costa and radius near the tip of the wing.

The *radius* (R) is a well-developed vein running parallel with the subcosta. The radial vein is forked as it reaches the margin. The *radial sector* (Rs) in the fore wing arises from the radius at the *radial fork* (rf), a considerable distance from the base of the wing; in the hind wing the origin is nearer the base. The radial sector gives off several posterior branches which vary in number. In the figure given these are s_1-s_{12} in the fore wing and s_1-s_{11} in the hind wing. The first seven in the fore wing and the first six in the hind wing extend straight to the margin. The other five (R_2, R_3, R_4, R_5, R_6) are bent in their midportions and run longitudinally forming the distal portion of the *pseudomedia* (M^1). Four of these (R_3, R_4, R_5, R_6) drop below the level of the pseudomedia, become bent again and run longitudinally forming the distal end of the *pseudocubitus* (Cu^1). Three of these (R_4, R_5, R_6) drop to the wing margin. It may be noted that R_1, R_2, R_3, R_4, R_5 and R_6 are two-branched at the wing margin. The fifth and sixth radial veins (R_5 and R_6) are often three-branched. The radial sector although often two-branched at the tip is usually unbranched.

The *radial cell* (r) is a simple cell lying between the main stems of R and M. The cells formed between the radial sector and pseudomedia by R_2 through R_6 inclusive are called the *upper series of Banksian cells* (b-b), and those formed below, between the pseudomedia and pseudocubitus by R_3 through R_6 inclusive are termed the *lower series of Banksian cells* (b^1-b^1). In the hind wing the first upper Banksian cell is that just distad of the *triangular cell* (t), which is really a rudiment of the first cell. This triangular cell is formed by Rs, R_6 and M_{1+2} . In the twelve specimens at hand an excellent series of gradations, from

a large triangular cell to no cell at all, were found. This decrease in size and final obliteration of the cell is due to the encroaching of the radial sector and sixth radial (R_6) vein on the media. The triangular cell, although absent in this particular specimen (No. 9) (Fig. 2), has been drawn in to show its general position.

The *media* (M) fuses basally with the radius for a distance, then diverges and runs to the *median fork* (mf) which in the fore wing is below and proximad of the radial fork, while in the hind wing it lies immediately below it. At the medial fork two branches (M_{1+2} and M_{3+4}) arise. In the fore wing, M_{1+2} arches upward while M_{3+4} extends concavely to it. M_{3+4} is then deflected cephalad and finally unites with M_{1+2} just beyond the radial cross-vein. These two elements then extend longitudinally for a short distance along the pseudomedia. M_{3+4} then drops down to the pseudocubitus, extends longitudinally and finally branches into M_3 and M_4 which reach the wing border. M_{1+2} extends further distad on the pseudomedia, drops to the pseudocubitus, runs distad and then branches into M_1 and M_2 which attain the border.

In the hind wing M_{1+2} and M_{3+4} separate at the medial fork. M_{1+2} arches upward and comes close to the radial sector, then extends longitudinally along the pseudomedia and drops to the pseudocubitus. M_{3+4} extends parallel to and below M_{1+2} and meets this when it drops to the pseudocubitus. These two extend longitudinally a short distance, then M_{3+4} splits into its component parts, M_3 and M_4 , which drop to the wing border. M_{1+2} extends further distad and then breaks up into its component parts, M_1 and M_2 , which likewise extend to the margin. M_1 , although usually simple, is often two-branched at the margin.

The cells formed by cross-veins between the media and cubitus are the *medial cells*. There are three (m_1, m_2, m_3) in the fore wing and two (m_1, m_2) in the hind wing. Cells formed by the forking of M_{1+2} and M_{3+4} are the *intramedial cells* (e_1, e_2) in the fore wing. In the hind wing these are formed by a cross-vein dividing the large intramedial cell into its two component cells (e_1, e_2).

The *pseudomedia* (M^1) in the fore wing arises from R near the base. It is formed by M up to mf, beyond this by M_{1+2} above e_1 , then by M_{1+2} and M_{3+4} united for half a cell's length, then by M_{1+2} and R_6 united for a short distance, then by R_6 , R_5 , R_4 , R_3 , R_2 overlapping each other in turn, and terminates in R_2 alone.

The *cubitus* (Cu) starts as a single vein basally. In the front wing it runs almost straight until it meets M_{3+4} as it drops onto the pseudocubitus. Cu_1 gives off three branches to the wing border. At the *cubital fork* (cf) which is proximad of the first cross-vein between the media and cubitus, one branch (Cu_2) is given off and swings down, soon sending two branches to the margin.

In the hind wing the cubitus branches at the *first cubital fork* (cf) which is closer to the base than it is in the fore wing. Cu_2 swings down and then as a single branch goes in a gentle curve to the margin. Cu_1 extends on a distance and again forks at the *second cubital fork* (cf^1), one branch going to the margin, the other up to the pseudocubitus and finally dropping two branches to the margin. (In the figure shown, one branch is dotted to show that in this particular specimen no such branch is present. One specimen, No. 4, showed that this branch was becoming atrophied as two-thirds of it was entirely gone. The other ten specimens had two entire branches.)

The *cubital cell* (cu) is a simple cell lying between the main stems of the cubitus and first anal. There are two cross-veins between Cu_1 and Cu_2 in the fore wing forming three *intracubital cells* (u_1 , u_2 , u_3), and one in the hind wing forming two *intracubital cells* (u_1 , u_2). In both wings there is a short cross-vein between Cu_2 and 1A just distad below the first cubital fork. In the hind wing, however, Cu_2 appears as part of 1A and the cross-vein in some cases is so short that these veins appear to adjoin each other.

The *pseudocubitus* (Cu^1) in the fore wing arises from the base of the wing and extends to cf as the main stem Cu. Beyond cf it is composed of Cu_1 , M_4 , M_3 , M_2 , M_1 , R_6 , R_5 , R_4 , R_3 overlapping each other in turn, and terminates in R_3 alone.

In the hind wing it arises near the base of the wing from R. It is formed by M for a short distance, then by M and Cu_1 united

up to mf; beyond this by M_{3+4} and Cu_1 united for over a cell's length, then by M_{3+4} , M_{1+2} , R_6 , R_5 , R_4 , R_3 overlapping each other in turn, and terminates in R_3 alone.

In both wings there are three anal veins. In the fore wing the *first anal* (1A) is two-branched, the *second anal* (2A) is also branched but the proximal branch unites with the *third anal* (3A). 3A is unbranched but has a double curvature causing it to come in contact with the margin of the wing between the base and the anal angle. A short cross-vein connects 1A with 2A.

In the hind wing all the anal veins are small and inconspicuous as compared with those in the fore wing. All are simple veins, but the third anal sends a small branch to the wing just proximal of the anal angle.

Two longitudinal series of cross-veins connect the posterior branches of Rs from s_1 to R_2 . The inner series is termed the *inner gradate* (g), and the outer series, the *outer gradate* (g^1).

The forks at the posterior end of the veins given off by the radial sector and the media are termed *distal forks* (df).

The cells between the proximal branch of Cu_1 and the proximal branch of R_2 are the *posterior series of cells* (p).

A few of the peculiarities present in the wings studied are as follows:

1. In specimens Nos. 1, 10 and 11. In both the fore and hind wings R_2 does not join the pseudomedia until after R_3 has dropped down to the pseudocubitus. The pseudomedia thus consists of a cross-vein between R_3 and R_2 . Also a cross-vein has been added from R_2 to M^1 , appearing as one of the upper gradate series.

2. In specimen No. 12. In the fore wing a cross-vein is added between R_2 and M^1 .

3. In specimen No. 2. In the hind wing the median portion of s_8 has atrophied.

4. In specimen No. 3. In the fore wing s_8 extends to M^1 , the remaining portion having atrophied.

5. In specimens Nos. 1, 3, 5 and 12. In the fore wing of No. 3, hind wings of Nos. 1 and 5 and both wings of No. 12, the penultimate portion of R_3 has atrophied. In No. 3, an additional cross-

vein has been added which connects the ultimate portion of R_3 and R_2 . Thus the average number of five lower Banksian cells is present. In Nos. 5 and 12, the cross-vein commonly between R_2 and R_3 connects R_3 with R_2 , and in No. 1 connects R_3 with M^1 . The portion of R_3 between M^1 and Cu^1 is still present. Thus only four lower Banksian cells are present.

6. In specimen No. 7. In the hind wing the portion of M_{1+2} between M^1 and Cu^1 has atrophied, making the second intra-medial cell (e_2) longer than usual and reducing the number of lower Banksian cells to four.

7. In specimens Nos. 3, 4, and 9. In the hind wing of No. 4 there are two complete branches of Cu_1 and one about two-thirds atrophied. In Nos. 3 and 9, this branch of Cu_1 that is on its way out in No. 4 has completely atrophied.

Tables I and II show in tabular form the number of main veins and cells in the twelve specimens of *Chrysopa perla* studied. The variation existing within the species is here graphically shown. The numbers opposite the veins represent the number of branches at the margin of the wing. The numbers opposite the cells represent the number of cells in the wing.

The numbers at the top of the sheet refer to the specimens as follows:

- No. 1. Sex?, Mondy, Sajan Mts., Siberia; determined by L. Navás
2. Female, Nowgorodow, Baikal, Siberia; determined by L. Navás
3. Male, Waldheim, Saxony, Germany; determined by L. Navás
4. Female, Linz, Austria
5. Female, Braunschweig, Germany
6. Female, Braunschweig, Germany
7. Female, Braunschweig, Germany
8. Female, Braunschweig, Germany
9. Male, Norway
10. Sex?, Norway
11. Sex?, Norway
12. Sex?, Norway

The right wings of specimens Nos. 1-10 inclusive and left wings of specimens Nos. 11 and 12 were studied.

- 1, 2, 3, 4, 5, 6, 7, 8, through Staudinger and Bang-Haas
- 9, 10, 11, 12, through Dr. G. C. Crampton

TABLE I (Continued)

Fore Wings	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12	Min.	Max.	Ave.
Third anal 3A	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Posterior branches from radial sector	11	13	13	13	12	14	11	13	12	12	13	12	11	14	12
s	5	6	6	7	6	8 ¹	5	6	5	5	6	5	5	8	5
g	6 ²	8	7	8	7 ²	9 ²	6	8	7	7	8	7	6	9	6
g ¹	10	9	13	12	11	12	10	11	8	9	10	8	8	12	10
df															12
Upper series of Banksian cells	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
b															
Lower series of Banksian cells	5	5	5	5	5	5	5	5	5	5	5	4	4	5	5
b ¹	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Radial cell															
r	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Medial cells															
m	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
e															
Cubital cell	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
cu															
Intracubital cells	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
u															
Posterior series of cells	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
p															

¹ One double, one Y.² One double.

TABLE II (Continued)

Hind Wings	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12	Min.	Max.	Ave.
Third anal	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3A															
Posterior branches from radial sector	11	13	13	12	12	13	11	12	11	11	12	11	11	13	11
s	5	5	5	6	6	7	5	6	4	5	5	4	4	7	5
g	6	7	7	7	6	7 ²	6	7	6	6	7	6	6	7	6
g ¹	10	10	10	11	8	11	10	10	8	10	8	9	8	11	10
df															
Upper series of Banksian cells	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
b															
Lower series of Banksian cells	4	5	5	5	4	5	4	5	5	5	5	4	4	5	5
b ¹	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Radial cell	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
r															
Medial cells	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
m															
Intramедial cells	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
e															
Cubital cell	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
cu															
Intracubital cells	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
u															
Posterior series of cells	16	16	15	15 ⁺	16	16	16	16	15	16	16	16	15	16	16
p															
Triangular cell	1	1	1	1	1	1	1	1	0	1	1	1	0	*	**

2 One double: * large; ** medium; *** small; ' very small.

From a study of this chart the following conclusions on the venation of *Chrysopa perla* have been drawn.

1. Veins found to be constant:

A. In both the fore and hind wings the following are present.

- Costa
- Subcosta
- 6 Radial veins
- Radial sector
- 4 Medial veins
- 2 Cubital veins
- 3 Anal veins

B. Veins in both the fore and hind wings with constant number of marginal branches.

Veins	Number of marginal branches	
	Fore Wing	Hind Wing
R ₁	2	2
R ₂	2	2
R ₃	2	2
R ₄	2	2
M ₂	1	1
M ₃	1	1
M ₄	1	1
Cu ₁	3	variable
Cu ₂	2	1
1A	2	1
2A	1	1
3A	1	1

2. Cells found to be constant:

A. Cells in both the fore and hind wings.

Cells	Number of cells	
	Fore Wing	Hind Wing
Upper series of Banksian cells	5	4
Radial cell	1	1
Medial cell	3	2
Intramedial cell	2	2
Cubital cell	1	1
Intracubital cell	3	2
Posterior series of cells.....	16	variable

It may be noted that in both the fore and hind wings great variation occurs in the number of inner and outer gradates and in the number of posterior branches from the radial sector. There is also variation in the number of branches borne by R_5 , R_6 and M_1 ; if one is three-branched, the other two are two-branched.

Tillyard (1916) in discussing the wing venation of the Chrysopidae lists a few venational differences on which he considers sound species of *Chrysopa* may be based. From the present study of the venation of *Chrysopa perla*, some of the characters listed by Tillyard are found to vary greatly within the species and so may be considered as being of doubtful value for specific purposes. These doubtful characters are as follows:

1. Number of free sectors; number of cells between R and R_s .
2. Number of closed cells beyond the arculus (proximal portion of the first intramedial cell) in the space between M^1 and Cu^1 in the fore wing; the number of same beyond mf in the hind wing.
3. Number of distal forks (df); the number of simple posterior cells (p) before the most proximal distal fork.
4. Number of gradate veins in both the inner and outer series.

Abdomen and its Appendages

The abdomen (Pl. IV, Figs. 17, 18, 19, 20, 21, 22) is composed of eight distinct spiracle-bearing segments followed by a ninth which is highly modified as the genital segment. The terminal segments are so indistinguishably united it is impossible to determine them.

The dorsum has a series of nine tergites (1t-9t). The *first abdominal tergite* (1t) is short and the anterior portion extends ventrally into the pleural region and bears the *first abdominal spiracle* (sp). The region surrounding the spiracle is connected with the metathorax by an extension of the metathoracic epimeron. Tergites two to seven inclusive are approximately equal in length. The *second tergite* (2t) is distinctly divided into two plates while the five following tergites show only a slight tendency toward division. Tergites two to eight inclusive of the male and two to seven inclusive of the female are subequal. The *eighth tergite* (8t) of the female is short.

The pleuron, or the membranous region between the tergites and sternites, is very distinct in *Chrysopa perla*. The *spiracles* (sp) are small semi-circular openings and are found in the first eight pleurites.

The ventral region has a series of seven sternites in the female (Figs. 17, 19) and eight in the male (Figs. 20, 22). The *first sternite* (1s) is short and, from its postero-dorsal region, a sclerotized rod extends dorso-cephalad into the pleural region. Ventrad of this rod another rod not connected with the sternite extends parallel to it. Sternites two to seven inclusive are sub-equal. The eighth sternite of the male is about half the size of the seventh.

Female Genitalia (Figs. 17, 18, 19):—The ninth tergite has apparently been retained and extends ventrad to form the valves (Pariser 1919). In *Chrysopa vulgaris* (Pariser 1919), the ninth tergite shows no secondary division cephalad of the *sensory area* (a). However, *Chrysopa perla* has a distinct suture in the lateral region, which is continued dorsad in some as a very faint suture and in others as a very distinct suture. This would seem to indicate that the ninth tergite has become secondarily divided into an anterior and posterior region. Crampton (1929) calls this posterior area in *Raphidia notata* the tenth tergite. Stitz (1909) shows the female of *Chrysopa perla* (Taf 29, Fig. 131) as having a transverse suture dividing the ninth segment into an upper and lower region. Pariser (1919) calls attention to this error. The specimens studied by the writer check with Pariser's observations.

Caudo-ventrad of the valves is a sclerotized area in the mid region of which is a slit-like genital opening, or *gonopore* (gp). Pariser (1919) calls this region the cover plate. Crampton (1929) in figuring *Corydalis cornuta* indicates the possibility that the ventral portion of the ninth tergite may be the proximal portion of the dorsal valve and the cover plate of Pariser the distal portion of the dorsal valve. A membranous protuberance, which in *Corydalis cornuta* (Crampton 1929) is termed the proctiger, is dorsad of the cover plate. The *anus* (an) opens dorsally on the proctiger.

Male Genitalia (Figs. 20, 21, 22):—The ninth tergite extends cephalo-ventrad. Pariser (1919) in figuring *Chrysopa vulgaris* terms this cephalo-ventral portion the valve. Crampton (1920) calls the corresponding portion of *Nymphes myrmelionides* the gonopleurite, and the dorsal portion containing the *sense areas* (a) the surgonopod. There is an elongated ventral plate which is probably the ninth sternite. Crampton (1918a) terms the corresponding sternite of *Corydalis cornutus* the hypandrium, or subgenital valve. The *lobe-like structure* (b) caudad of the subgenital valve is apparently the sublaminae (Crampton 1918a). A large membranous genital swelling extends caudad from between the gonopleurite and subgenital valve. On this swelling are three *light gray areas* (k).

The male genitalia of *Chrysopa perla* figured by Stitz (1909) (Taf. 26, Fig. 41) is entirely different from the one figured in this thesis. The specimens used by the writer were compared and found to check with a male determined by Navás as *Chrysopa perla*. This leads the writer to believe that the male genitalia figured by Stitz is that of another species.

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ABBREVIATIONS

a—sense area	e—eye
aba—posterior basalar plate	ecx—eucoxa
aem—anepimeron	em—epimeron
aes—anepisternum	es—episternum
an—anus	esu—epistomal suture
anf—antennifer	et—extensor tendon
ar—arolium	f—furca
as—antennal socket	fe—femur
at—anterior arm of tentorium	fl—flagellum
ax—notopterales	for—occipital foramen
	fr—frons
b—lobed portion on male genitalia	frp—frontal pit
bc—basicardo	fs—furcasternum
bg—basigalea	fsu—frontal suture
bl—basilacinia	ft—flexor tendon
bm—basimandibula	
br—brustia	g—ginglymus
bs—basisternum	ge—gena
	gp—gonopore
c—condyle	gu—gula
cd—cardo	gup—gula pit
cl—clypeus	
	il—interlabium
de—disticardo	in—incisor region
dg—distigalea	
dle—dorsal lateral cervicale	k—light spot on male genitalia
dt—dorsal arm of tentorium	kem—katepimeron
	kes—katepisternum

la—distilacinia
lc—laterocervicale
li—labium
lp—labial palp
lr—labrum
ls—laterosternum
lst—labiostipes

md—mandible
me—meron
mn—mentum
mo—mola
mp—maxillary palp
ms—marginal sclerite
mx—maxilla

o—alifer
ocp—occiput
os—occipital suture

p—pleurite
pa—pleural arm
pd—pedicle
pfr—palpifer
pg—fused glossae and paraglossae
pgr—palpiger
pm—phragma
pn—pronotum
poc—postcervicale
pot—postergite

1, 2, 3, 4, 5, 6—articulatory processes

In Plate I.

1, 2, 3—articulatory processes for trochanter

In Plate III.

1—suralare
2—adanal process
3—articulatory process for wing
4—articulatory process for coxa
5—coxifer
6—median articulatory process

pr—pleural ridge
prt—pretergite
ps—parascutellum
psc—prescutum
psl—postscutellum
pt—posterior arm of tentorium
pta—ungues

s—sternite
sa—subalar plate
sc—scutum
sep—scape
sgs—subgenal suture
sl—scutellum
sm—submentum
smo—submola
sp—spiracle
st—stipes

t—tergite
ta—tarsus
tg—tegula
ti—tibia
tis—tibial spur
tn—trochantin
tnt—body of tentorium
tr—trochanter
ts—temporal suture

v—vertex

VEINS

C—costa
Sc—subcosta
R—radius
R₁—1st branch of radius
R₂—2d branch of radius
R₃—3d branch of radius
R₄—4th branch of radius
R₅—5th branch of radius
R₆—6th branch of radius
Rs—radial sector
M—media
M₁—1st branch of media

M₂—2d branch of media
M₃—3d branch of media
M₄—4th branch of media
M¹—pseudomedia
Cu—cubitus
Cu₁—1st branch of cubitus
Cu₂—2d branch of cubitus
Cu¹—pseudocubitus
1A—1st anal
2A—2d anal
3A—3d anal
s₁—1st posterior branch from
radial sector

s_7 —7th posterior branch from radial sector	cuf^i —2d cubital fork
s_{11} —11th posterior branch from radial sector	df —distal fork
s_{12} —12th posterior branch from radial sector	mf —medial fork
cuf —1st cubital fork	rf —radial fork
	g —inner gradate series of veins
	g^i —outer gradate series of veins
	x —subcostal cross-vein

CELLS

$b-b$ —upper series of Banksian cells	m_3 —3d medial cell
b^i-b^i —lower series of Banksian cells	cu —cubital cell
r —radial cell	u_1 —1st intracubital cell
e_1 —1st intramedial cell	u_2 —2d intracubital cell
e_2 —2d intramedial cell	u_3 —3d intracubital cell
m_1 —1st medial cell	$p-p$ —posterior series of cells
m_2 —2d medial cell	t —triangular cell
	pt —pterostigma

PLATE I

Figure 1.—Right fore wing of male.

Figure 2.—Right hind wing of male.

Figure 3.—Antenna.

Figure 4.—Head, frontal aspect.

Figure 5.—Left mesothoracic leg of female, anterior aspect.

Figure 6.—Left mesothoracic tarsus and distal end of tibia of female,
ventral aspect.

Figure 7.—Tentorium, mesal view along the median axis.

Figure 8.—Tentorium, caudal aspect.

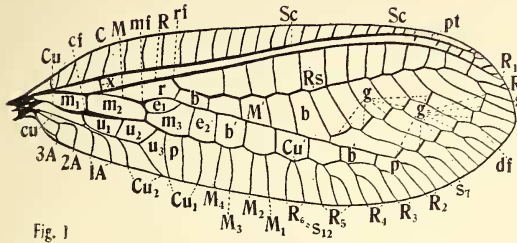


Fig. 1

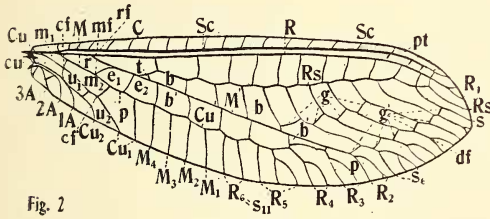


Fig. 2

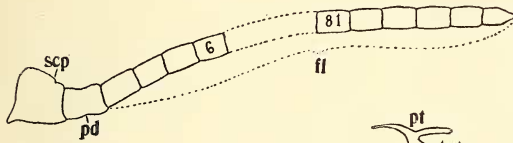


Fig. 3

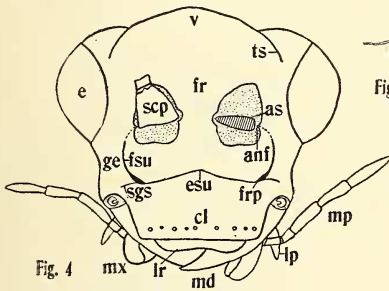


Fig. 4



Fig. 7

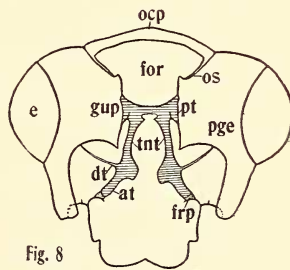


Fig. 8

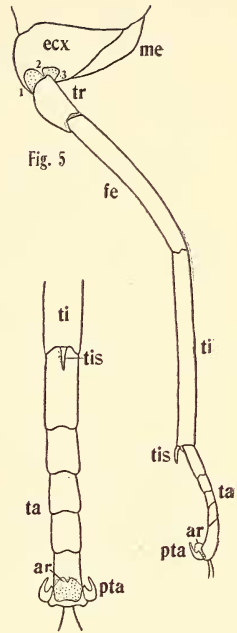


Fig. 5

CHRYSOPA PERLA

PLATE II

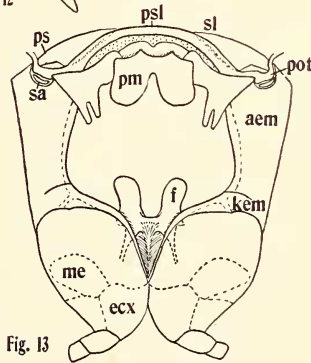
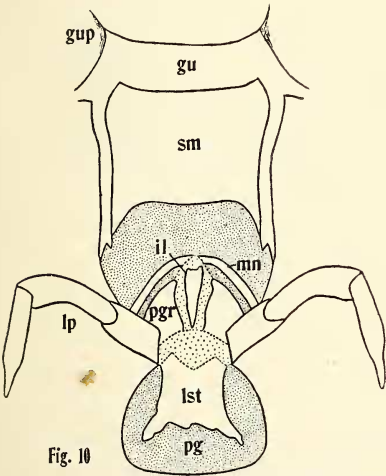
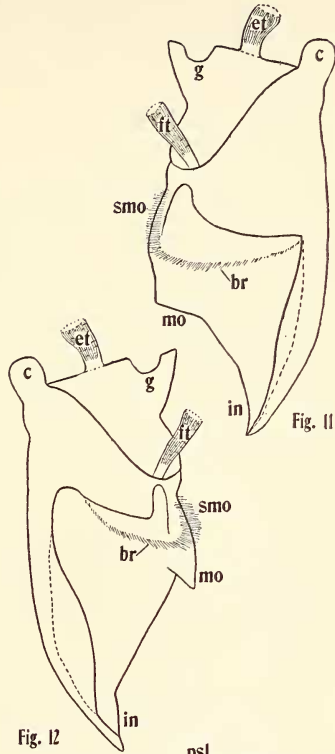
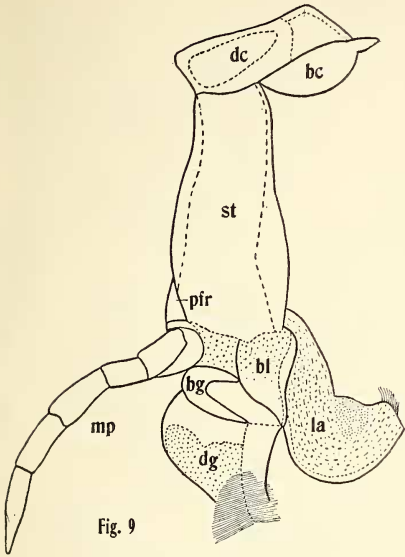
Figure 9.—Left maxilla, posterior aspect.

Figure 10.—Labium, posterior aspect.

Figure 11.—Right mandible, anterior aspect.

Figure 12.—Left mandible, anterior aspect.

Figure 13.—Mesothorax, caudal aspect.



CHRYSOPA PERLA

PLATE III

Figure 14.—Mesothoracic endoskeleton, lateral aspect.

Figure 15.—Metathoracic endoskeleton, lateral aspect.

Figure 16.—Thorax, lateral aspect.

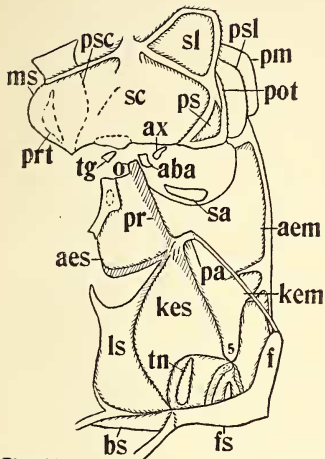


Fig. 14

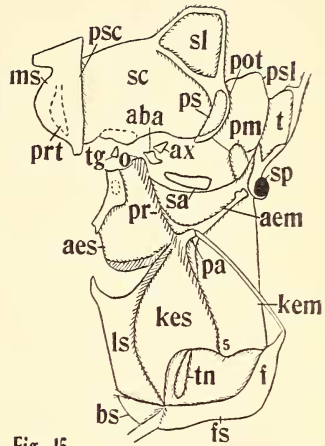


Fig. 15

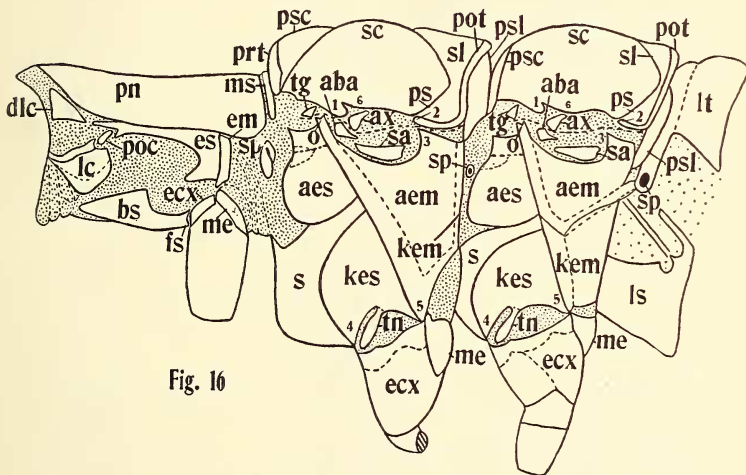


Fig. 16

CHRYSOPA PERLA

PLATE IV

- Figure 17.—Abdomen of female, lateral aspect.
Figure 18.—Genitalia of female, dorsal aspect.
Figure 19.—Genitalia of female, ventral aspect.
Figure 20.—Caudal portion of abdomen of male, lateral aspect.
Figure 21.—Genitalia of male, dorsal aspect.
Figure 22.—Genitalia of male, ventral aspect.

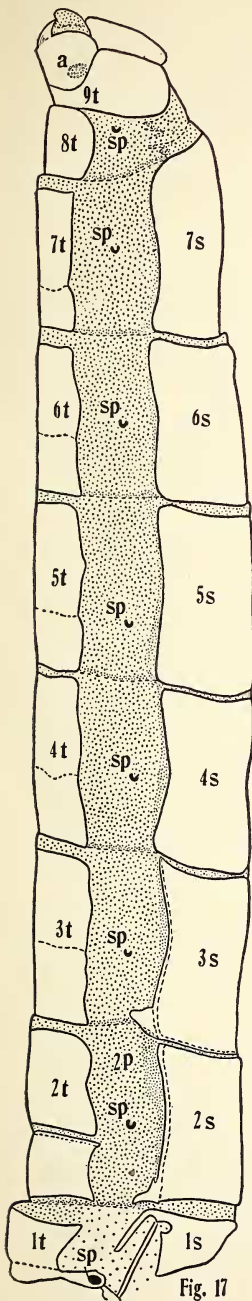


Fig. 17

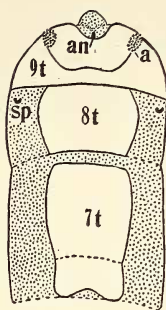


Fig. 18

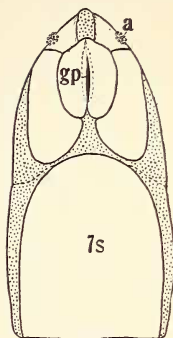


Fig. 19

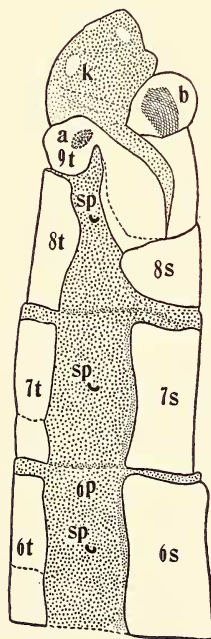


Fig. 20

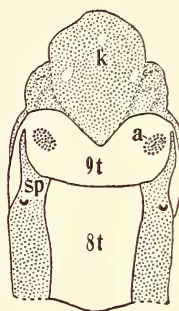


Fig. 21

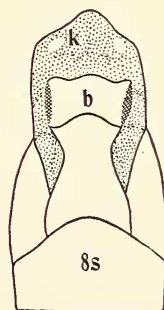


Fig. 22